Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

THE FORMATION OF ANTIBODIES IN RATS FED ON PURE VEGETABLE PROTEINS (OSBORNE-MENDEL STUNTING FOOD) *

LUDVIG HEKTOEN

(From the Memorial Institute for Infectious Diseases, Chicago.)

Osborne and Mendel have made the important discovery that by feeding white rats certain pure vegetable proteins normal growth is arrested without disturbance of the general health, the animals resuming growth on the resumption of ordinary food or when certain amino acids are furnished.[1] As I was engaged in a study of the formation of antibodies under different conditions, it occurred to me that it would be of interest to try to determine whether or not the formation of antibodies proceeds in the usual way in rats whose growth is arrested by this means. Accordingly, the amount of specific lysin for sheep corpuscles, produced in normal and stunted animals under comparable conditions, has been determined.

The blood-serum of white rats normally causes lysis of sheep corpuscles. This action is dependent on an amboceptor-complement mechanism, because on being heated at 56 C. for thirty minutes the serum loses its lytic power, which is restored, however, on the addition of complement in the form of fresh guinea-pig serum, in quantities that in themselves do not cause laking of sheep corpuscles. The amount of amboceptor in normal rat serum varies, but usually no lytic action is obtained in dilutions of the serum above 1 to 96. When white rats are injected with defibrinated sheep blood, there is produced a specific lysin for sheep corpuscles which follows a course, in general, like that of other antibodies under similar conditions. Two methods of injection have been tried: a single intramuscular injection of 1 c.c. of a 10 per cent. suspension of sheep blood per kilo of weight; and a single intraperitoneal injection of 1 c.c. of a 10 per cent. suspension per kilo. The amount of lysin produced is much greater in the case of the second method, which is the method used in these experiments. In either case

---

* Received for publication, May 19, 1914.

[1] Beobachtungen über Wachstum bei Fütterungsversuchen mit isolierten Nährungssubstanzen. Hoppe-Seyler's *Ztschr. f. physiol. Chem.*, 1912, 80, p. 307; Amino-Acids in Nutrition and Growth, *Jour. Biol. Chem.*, 1914, 17, p. 325.

the high point in the new production of lysin is achieved early, about the fifth or sixth day and occasionally even earlier, and by the tenth or eleventh day the concentration begins to lessen, the normal level being reached or closely approached in from thirty to forty days after the injection. In other animals, injected with a single dose of antigen, the climax in the production of antibody usually does not occur until a few days later than is the case in the white rat after the injection of sheep blood.

On account of the small size of the rat it is necessary to bleed from the heart in order to obtain enough serum. This is not difficult until adhesions form in consequence of the repeated punctures; however, quite a few animals die from hemorrhages into the pericardium. The possible effect of the loss of blood must not be overlooked; in animals weighing 75 to 150 gm. the withdrawal of 0.3 to 0.5 c.c. of blood is a serious loss, and as loss of blood is believed to stimulate the production of antibodies in other animals, it is highly probable that in the rats of these experiments the production of lysin was stimulated by the bleedings. In judging the results, it must be borne in mind that a complicating factor of this kind no doubt may have a varying effect in different animals.

In order to learn the effects of the Osborne-Mendel food on antibody production, two sets of experiments have been carried out, each involving a group of stunted and of normal rats. Similar results were obtained in each case and the essential points are illustrated in Charts 1 and 2, which give the weight curves and the antibody curves of one set. The stunted rats were placed on the special food five days before the injection of the sheep blood, so that the first day of Chart 2 corresponds to the sixth day of Chart 1. The materials for the food were supplied by Professor Mendel, to whom I am greatly indebted, and the food was prepared according to his directions, as follows: take 380 gm. corn gluten (specially prepared), 280 gm. "protein-free milk," 20 gm. Duryea's corn starch, 320 gm. lard; melt the lard at a low temperature and stir into it the other ingredients previously mixed; cool after thoroughly mixing, and put through an absolutely clean meat chopper several times. The paste keeps well in glass jars. The rats were kept supplied constantly with all they would eat, care being taken to pack the food well in suitable cups. The cages were kept clean and fresh water supplied regularly. That this food arrests growth is shown at a glance by Chart 1. The control animals were fed as usual.

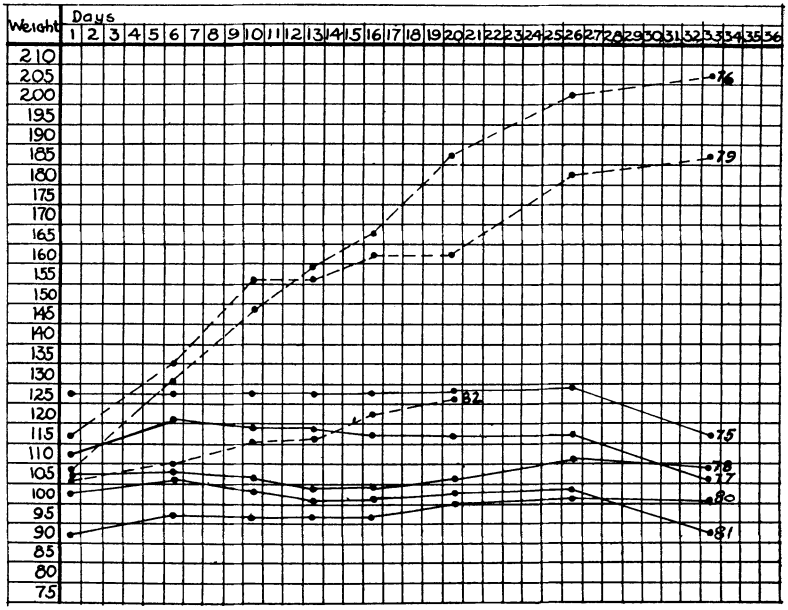

CHART 1.—The Weight Curves. The solid lines indicate the weights of rats on the Osborne-Mendel food; the broken lines the weights of rats on ordinary food.

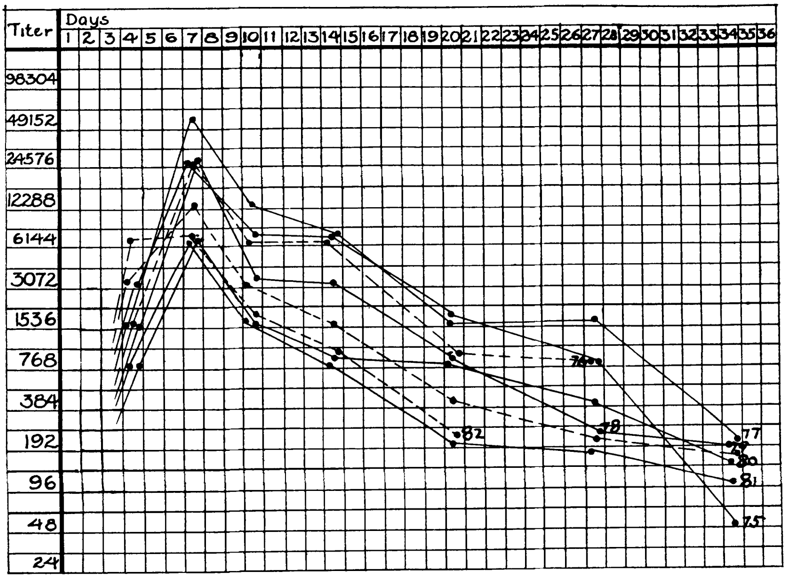

CHART 2.—Antibody (Lysin) Curves. The solid lines refer to rats on the Osborne-Mendel food, the broken lines to rats on ordinary food. Day 1 on this chart corresponds to the sixth day of Chart 1.

In order to reduce the chances of accidental death the first bleeding was made on the fourth day after the injection of the antigen (1 c.c. of a 10 percent suspension of sheep blood per kilo of weight intraperitoneally), then every third day two times, and after that at longer intervals. The determinations of the lysin were made by finding the highest dilution of the serum, heated at 56 C. for thirty minutes, and complemented with guinea-pig serum (.0125 c.c.), at which distinct lysis was produced. The total quantity in each tube was 0.6 c.c., including 0.2 c.c. of a 5 percent suspension of sheep corpuscles, carefully washed, .0125 c.c. of guinea-pig serum, and the requisite amount of heated rat serum, the rest being salt solution. The mixtures were incubated for two hours and then placed in the ice-box until the following morning.

The results require no comment (Chart 2). The curves run fairly parallel; there is no outstanding difference in the results in the stunted and the normal rats, and there is just as much variation between the individual members of one group as of the other. That there should be variation is not surprising especially in view of the probable influence of the bleedings, to which attention has been called.

It appears then that, so far as the results of these experiments indicate, the arrest of growth in rats by the Osborne-Mendel method does not cause any disturbances in the production of antibodies.